

U. S. COMMISSION OF FISH AND FISHERIES,  
GEORGE M. BOWERS, Commissioner.

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# EXPERIMENTS IN PHOTOGRAPHY OF LIVE FISHES.

BY

R. W. SHUFELDT,  
*Captain, Medical Corps, United States Army.*

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Extracted from U. S. Fish Commission Bulletin for 1899. Pages 1 to 5. Plates 1 to 9.

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WASHINGTON:  
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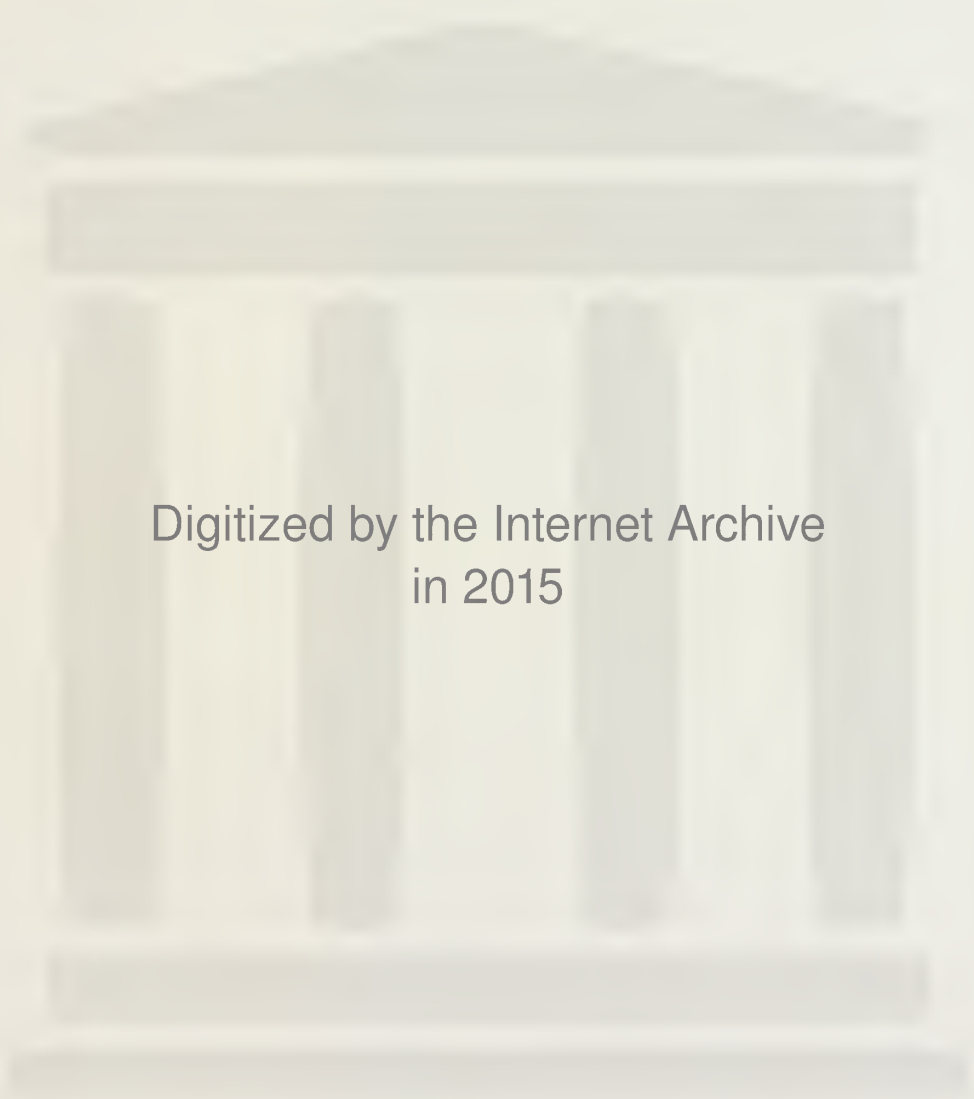
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THE MARINE GROTTO IN THE UNITED STATES FISH COMMISSION BUILDING AT WASHINGTON, D. C. (Taken in July, 1897.)



## EXPERIMENTS IN PHOTOGRAPHY OF LIVE FISHES.

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Up to the present time very few photographs of living fishes have been reproduced and published, and, as compared with the photography of other living forms, attempts or successes in this line are extremely rare. There are a number of methods by means of which fish may be photographed in their natural element, with natural surroundings, as, for example, it is possible to accomplish it beneath the surface of the water by the use of some such contrivance as the subaquatic camera used by Dr. J. E. Romborsts, or that of M. Bouton, or the apparatus of Regnard. By the employment of instantaneous photography some fishes have been taken in the air, in the act of "leaping," as in the case of salmon, or in the act of flight, as in the case of the flying-fish. Such pictures as these latter, however, illustrate peculiar habits rather than topographical characters of the forms thus secured. To obtain these we must resort to the photography of living fishes in suitable aquaria and under proper conditions. In such receptacles the types to be photographed may be taken either through the glass sides of the aquarium (with or without background) or the exposure may be made from above. This, of course, would depend upon the form of the fish and its habits in nature, or, in other words, whether the subject was a bass or a flounder. Again, certain fish in nature have the habit of occasionally resorting to the dry land, and when the opportunity offers species of this kind may be taken upon terra firma in various situations, as in the case of the peculiar gobioid *Periophthalmus*.

The experiments to be described in the present contribution, however, will be restricted to a few the author has made at the aquaria of the U. S. Fish Commission building in Washington in July, 1897, and upon various occasions since. The fish in these cases were all medium-sized teleostean types, and the photographs were first taken through the glass sides of the aquaria in which they are kept in the "Marine Grotto"; and afterwards in a special aquarium placed in the court-yard of the building during the forenoon of a perfectly clear day in July (1898)—two very different conditions. In the first instance the aquaria consist of a series of tanks arranged around a roofless corridor, thus admitting sunlight, when protective awnings are not in use, only from above. Within the grotto, this series of aquaria comes flush by glass-fronts with the wall of the long room, so named. Here they are of glass, 4 or 5 feet above the floor, and as one enters the grotto the impression is given of mural pictures wherein the fish-subjects are alive and moving about. The walls of the grotto

and its entrance are of tin, so modeled, painted, and sanded as to give the appearance of having been built in solid freestone. Practically all the light that gets into the place is through the glass fronts of the series of aquaria and the doorway passage. It is an admirable arrangement and admits of the study of the forms of many kinds of fish and plants, and certain invertebrata as well. To a limited extent it likewise permits the study of some of the habits of the forms exhibited.

To one having but little knowledge of the use of the camera, it would appear to be but a simple matter to photograph under such apparently favorable conditions, but such is by no means the case. In the first place, in most instances the incessant, rapid, and often erratic movements of the fish themselves have to be taken into account; the aquaria being large, we have in the second place the difficulty of prompt focussing to contend with, due to the latitude enjoyed by the smaller and more active forms. Thirdly, there is the question of reflection, and this, taken in connection with the light, is a serious problem. Reflections are especially troublesome, as the glass fronts of the aquaria receive them from all directions, so that, after focussing, a careful study of the image upon the ground-glass will show these reflections not only from some of the other aquaria, but possibly the photographer and his camera besides. All this must be carefully guarded against.

In the early part of July, 1897, I made a number of attempts to photograph the fish contained in these aquaria through the glass-fronts, and in several instances I was successful. Where failure resulted it was due to some of the causes enumerated above, or, as in the case of a catfish, due to the high light upon the fish itself. High lights on the bodies of fish, if present at the time the exposure is made, will in the prints made from such a negative produce areas of white wherein all detail is absent. This is to be especially avoided, and often can only be overcome by shielding the aquarium from the sun above. An umbrella will in nearly all cases serve this purpose.

The camera employed upon this occasion was an old-model Blair tourograph, with a Vöigtlander lens (No. 1) (27,967), an instantaneous shutter of the Low pattern, Seed's gilt-edge plates (5 by 8). I used stops as any special case demanded. A tripod is absolutely essential to success in this kind of work. The instrument was set up in front of one of the more favorable aquaria and focussed upon the part desired and an inch or two *beyond* the surface of the glass. An armed plate-holder was inserted in place and the "snap" set. Patient waiting for an exposure when the fish swims to the place where you want it is necessary. Care must be taken in drawing or pushing back the slide to the plate-holder, and some of my failures were due to complications of this nature.

The first exposure was made upon a large pike (*Lucius lucius*), some 18 or 20 inches long and in good color and condition. It had a duration of about 2 seconds, at which time the plane of the left side of the fish's body was nearly parallel to the plane of the glass, and about 3 inches from its inner surface. A quarter of an inch diaphragm was used, and the subject remained practically motionless during the time of exposure. Overhead the light was somewhat diffused, and an additional disadvantage presented itself in the fact that the color of the pike closely simulated the shade of the metal-back of the aquarium, thus rendering strong outlines of the resulting negative a matter of doubt. However, the picture (plate 7, lower figure) was fairly good, and on comparing it with the figure of this species in "The Fisheries and Fishery Industries of the United States" (plate 183, upper figure) it is to be observed that in the living fish the pectoral fins are extended almost directly downward; and further, that the



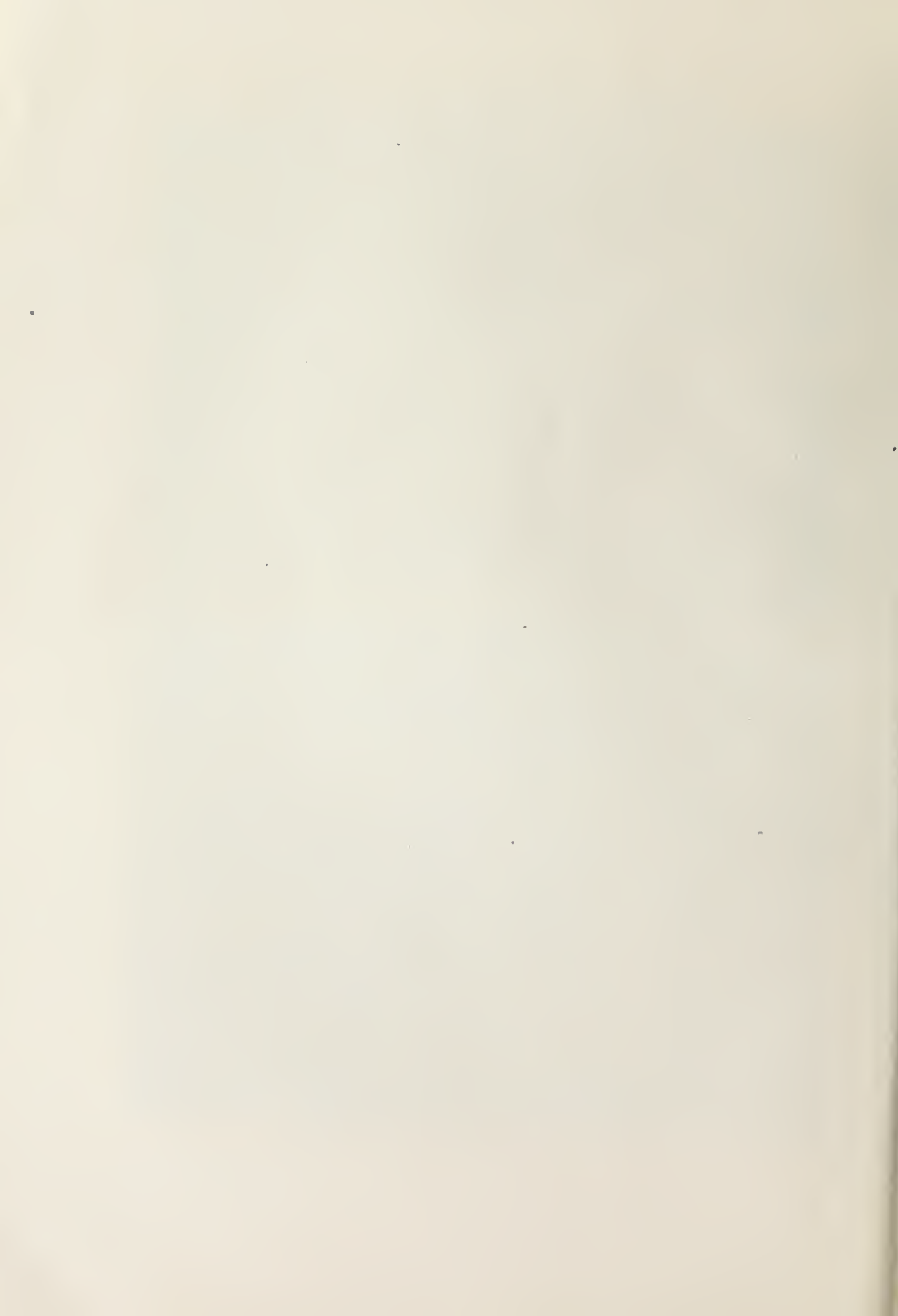
extremities of the forks of the tail are distinctly rounded and not acute, as in the aforesaid drawing. In fact, the caudal fin, or tail, in the latter is incorrect in outline, and there are still other differences to be observed upon comparing the figure of the present paper with the figure given us by Goode, pointing to inaccuracies in the latter. Here is where the great value of the camera comes in. In time, with suitable subjects taken under the most favorable conditions, pictures of fish (as in the case of other animal forms), produced by half-toning processes from faultless photographs, will surely supersede in biological literature the often inaccurate figures that now illustrate it. This is what we strive to accomplish in our efforts to obtain the best possible photographic negatives of fish—live fish in their natural element, with normal surroundings.

On the same day I attempted to photograph the two species of sun-fish then in the aquaria. One of these was the common pumpkin-seed (*Eupomotis gibbosus*) and the other the long-eared sun-fish (*Lepomis auritus*, plate 3, upper figure). In the aquarium at the south end of the grotto there were upward of two dozen specimens of the former, while a handsome male of the latter species, with three or four females, were living in another tank at the side of the room, where the light was much more favorable. By instantaneous exposure I secured two fine negatives of the common sun fish. One of these had twenty fish in it, all of which were swimming at the time, but the resulting picture shows not the slightest degree of motion in any one of them. There were nearly as many specimens on the second negative, here shown in plate 3, lower figure, and published for the first time in the *Photographic Times*, of New York. These results exemplify what may be expected from a highly colored fish, though rather a dark one, attempted under by no means favorable conditions, and where reliance was mainly placed upon tact, patience, and the best material that the market afforded. It will be observed that those specimens which were deep down in the water took the darkest, while those nearer the surface showed better definition. Nearly all of them, however, give the external characters of the species pretty well, and surely are far more interesting than many illustrations frequently seen in zoological works.

In the case of *Lepomis auritus* the subject selected was the single male fish, and for fully two hours, upon an intensely sultry afternoon, I was obliged to wait before this beautiful specimen came into the proper place to be photographed. The result, however, fully compensated for the delay, and the photograph is an absolutely accurate representation of the male long-eared sun-fish of our American ichthyfauna.

About a week after making these experiments very good results were also obtained with the striped sea-robin (*Prionotus erolans*) and with the naked star-gazer (*Astroscopus guttatus*). The former was taken while resting upon the bottom of the aquarium, while the latter was secured in two positions, the one where it had settled down upon a piece of flat stone, and the other an instantaneous exposure, showing the fish in the act of hiding itself in the sand, a very interesting habit that it constantly exhibits. The reproduction of my photograph of the star-gazer is shown in plate 7, upper figure, and it is a very accurate representation of this species as it appears in life.

This work was not resumed until July of the following year, when the present Commissioner, Hon. George M. Bowers, extended me additional facilities. Mr. Edw. S. Schmid had also had a special aquarium manufactured for my use, and I had the kind assistance in the experiments of Mr. Leighton G. Harron, the superintendent of the Aquaria at Central Station in Washington. I made a number of exposures upon needle-gars, black bass, and crappie. With both the former species I failed for not





COMMON SUN-FISH (*Eupomotis gibbosus*). Upper figure, natural size; lower figure, slightly reduced.







LONG-EARED SUN-FISH (*Lepomis auritus*). Reduced about one-third.



GROUP OF COMMON SUN-FISH (*Eupomotis gibbosus*).







THE LARGE-MOUTHED BLACK BASS (*Micropterus salmoides*). Slightly reduced.



THE WHITE PERCH (*Morone americana*). Two-thirds natural size. Represents the fish searching for food along the bottom of the aquarium, similar to the habit it has in nature.





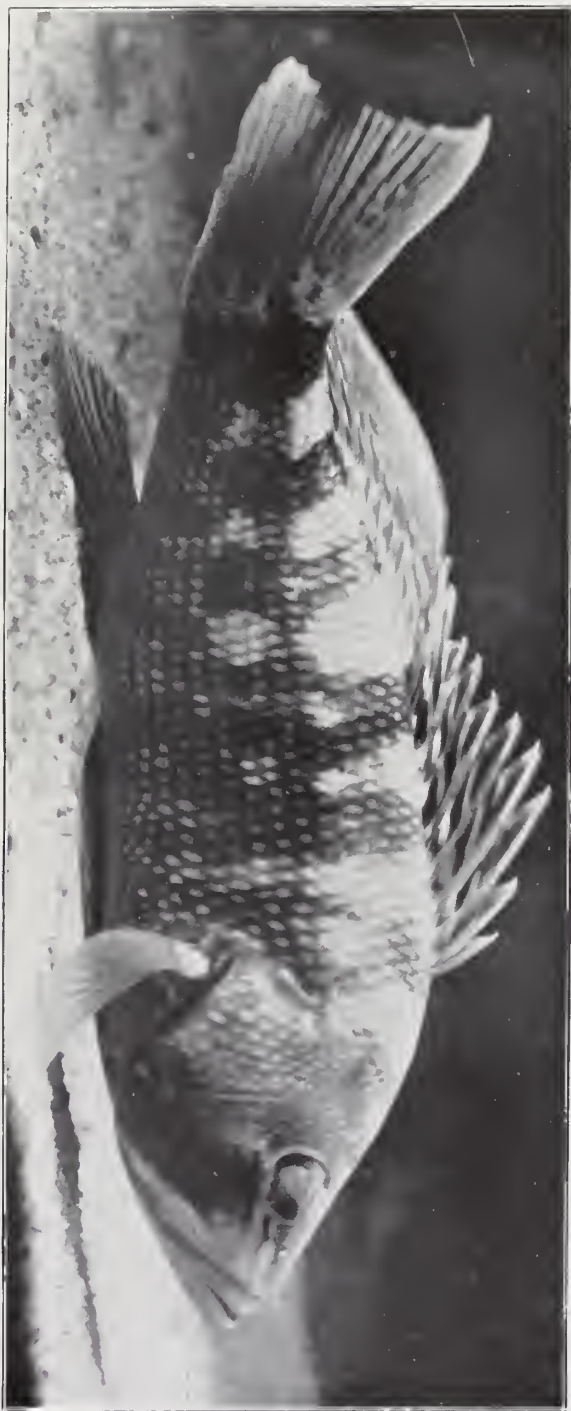
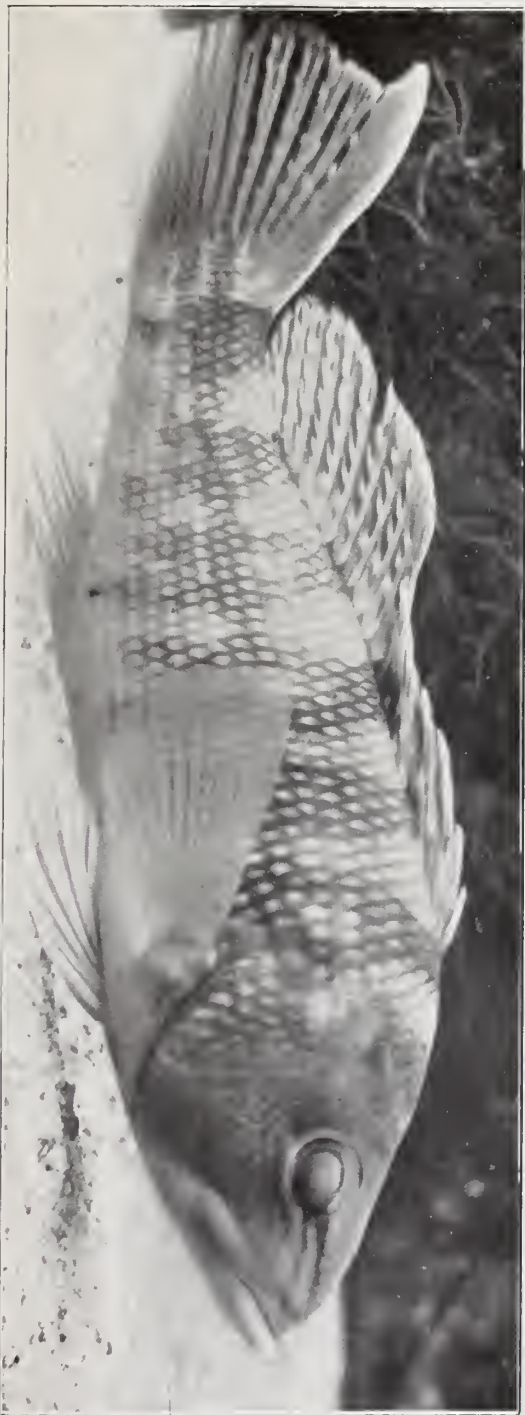
THE SPOTTED SEA TROUT OR SQUETEAGUE (*Cynoscion maculatum*). One-half natural size.



THE TAUTOG OR BLACK FISH (*Tautoga onitis*). Nearly natural size. Exhibiting the fish resting on the bottom, a habit it has commonly in nature.







THE SEA BASS (*Centropristis striatus*). Different specimens.





THE PIKE (*Lucius lucius*). Left lateral view.



THE NAKED STAR-GAZER (*Astroscopus guttatus*). Slightly reduced.







THE BROOK TROUT (*Salvelinus fontinalis*). Natural size. Taken July, 1897.



THE CAT-FISH (*Ameiurus nebulosus*). Somewhat reduced.





YOUNG RAINBOW TROUT (*Salmo gairdneri*). Four hundred and fifty specimens in the aquarium when instantaneous exposure was made.





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